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Abstract

THE DEVELOPMENT AND EVALUATION OF URANIUM MAGNOX FUEL ELEMENTS

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1. The paper describes some of the main features of the out-of-pile mechanical development of the magnox-uranium fuel elements in use or to be used in U.K. power reactors, and covers the three year period to December 1963. It is devoted entirely to the development of the stacked design of element, and deals principally with the problems associated with gas forces and stacking loads. Experimental and analytical techniques for the evaluation of fuel element designs have been developed in these fields. They are described and the criteria by which an element is judged acceptable are given. Certain environmental problems, for example thermal cycling fatigue, are not discussed but some idea of the work involved in the development and proving of a fuel element is given.

2. Stability and endurance requirements for the polyzonal fuel element have led to the introduction of a spring stabilising device and a braced splitter assembly with the splitters reduced in height between braces. The local reduction of splitter height reduces the element disturbing forces and virtually eliminates the net splitter force in these regions, and so eases the task of stabilising the element and supporting the splitter. Bowing restraint is provided by the splitter and brace structure at brace positions.

3. The spring is designed to give a force, which, after relaxation caused by irradiation and thermal effects during service, is adequate for complete

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stability. It is expected that fin tip movements and splitter tip movements at a brace caused by both gas and bowing loads will be limited to values such that the resulting degradation of heat transfer performance is small and acceptable.

4. During the development period under review the demand for increased heat transfer performance has taken helical can manufacture to the limit of economic feasibility. The chosen design solutions to the problems of gas forces and stacking loads have been consolidated and whilst there is no doubt that alternative solutions are possible, the incentive in terms of performance benefit for developing them is small. On the other hand the herringbone or chevron element appears attractive in that it offers a reduction or elimination of fittings external to the can and should possess an inherent stability. This type of element is being assessed using similar techniques to those developed for the polyzonal element. It has yet to be demonstrated that stability can be achieved without a mechanical device; even so the design has merits which have resulted in its adoption for the second reactor at Sizewell.